



PATENT
Customer No. 22,852
Attorney Docket No. 1165-858

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
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Jinichiro Kato et al.) Group Art Unit: 1625
)
Application No.: 10/070,740) Examiner: Taylor V. Oh
)
Filed: March 12, 2002)
)
For: Ester-Forming Monomer)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE

In the Office Action of September 24, 2003 the Examiner rejected claim 14 under 35 U.S.C. § 112, second paragraph on the grounds that the phrase "an oligomer thereof" is indefinite.

However, it is submitted that though the term "oligomer" is not specifically defined in the specification, one skilled in the art of polymers knows that it is a polymer molecule consisting of only a few monomer units, for example a dimer, a trimer, or a tetramer. See attached Exhibit A which is a copy of page 759 of the 10th edition of the Condensed Chemical Dictionary. In the synthesis of poly(trimethylene terephthalate), an intermediate polymeric product composed of a few trimethylene terephthalate-repeating units would be considered an "oligomer thereof." In the context of the description, it is therefore obvious that the term "oligomer" means a low molecular weight form of the polymer.

In this connection reference is made to page 7, lines 16 and 17 of the cited Gallagher reference (WO97/49652) where it also states that by oligomer "is meant a low molecular weight form of a given polymer."

Also attached as Exhibit B is a copy of pages 180 and 181 of a dictionary used by chemists and chemical engineers in Japan, The Kagaku Dai-jiten; Encyclopedia Chimica (printed by Kyoritsu Printing Company) Vol. 2 (1969). Under the entry "Oligomer" there is described, "A low polymer having a few polymeric repeating units, generally the molecular weight of which is roughly not greater than 1000. It is generally soluble in an organic solvent, and being separated by fractional distillation. Examples include a vapor phase or high temperature ionic polymer of styrene, ethylenic teromer, cyclic tetramers or low polymer of ethylene oxide, propylene oxide, a polypropylene formed under acidic catalyst and a caproluctam based low polymer."

For these reasons it is submitted that the term "oligomer" recited in claim 14 is a technical term clearly known to one of ordinary skill in the art. Accordingly, it should not be considered indefinite and vague in the art. Withdrawal of the rejection of process claim 14 under §112, second paragraph and its allowance with claims 15 and 16 dependent therefrom is requested.

In the Office Action, the Examiner also rejected claims 13, 17, and 18 under 35 U.S.C. § 103(a) for being obvious over Gallagher.

Applicants' invention as set forth in claim 13 relates to an ester-forming monomer obtained from the depolymerization of poly(trimethylene terephthalate), wherein the ester-forming monomer is 1,3-propanediol containing acrolein in an amount not greater than 0.5 wt% and has a Hazen Color Number of 40 or less.

The claimed 1,3-propanediol provides an ester-forming monomer of high purity, so that a polymer with quality equivalent to or above that obtained using virgin monomer can be obtained from it when it is reused for polymer production.

Claim 17 relates to the polymer obtained from the polymerization of the 1,3-propanediol of claim 13, the polymer having a brightness-indicating L value of 75 or more and a yellow-indicating b value of 10 or less and claim 18 a fiber, film, or shaped article formed of the polymer of claim 17. In this connection, reference is made to the following Table A, which is Example 4 as set forth on pages 17 and 18 of the specification.

Table A (Example 4)

Raw monomers		3GT polymer	
<u>DMT</u>	<u>PDO</u>	L value	b value
Commercially available	Recovered in Example 1	88	2.1
Commercially available	Commercially available	85	8

DMT = dimethyl terephthalate

PDO = 1,3-propanediol

3GT = poly(trimethylene terephthalate)

Note that the polymer obtained from the recovered PDO was even better than that obtained from virgin PDO.

Because the reactivity of 1,3-propanediol is relatively higher than that of ethylene glycol, the recycled use of ester-forming monomer recovered from the depolymerization of waste poly(trimethylene terephthalate (3GT) is hampered by the generation of

acrolein and its reactivity as discussed in the specification (see page 3, line 14 to page 4, line 36).

When a recycled ester-forming monomer, e.g., 1,3-propanediol, is reused as a polymerization starting material for 3GT, the polymerization rate is slowed and the whiteness of the 3GT obtained is not acceptable unless the acrolein content of the monomer is reduced to a prescribed amount. Another problem is the acrolein is a reactant with 1,3-propanediol, which greatly impedes separation of the recovered ester-forming monomer by distillation or the like.

It is inevitable in a reaction involving a depolymerization of 3GT that a portion of the 1,3-propanediol produced by the depolymerization thereof readily converts into acrolein or allyl alcohol and that, once acrolein is generated in the depolymerization system, the resulting reaction product causes further reactions leading to conversion to numerous different high boiling point substances close to that of 1,3-propanediol. This makes their separation difficult to perform. For distillation of dialkyl terephthalate, such as methyl terephthalate, similar problems are encountered. When obtaining terephthalic acid, acrolein and acrolein degeneration products included in the terephthalic acid make separation by recrystallization difficult.

As noted in the Amendment filed July 14, 2003, Gallagher discloses a method for recovering depolymerization products from polymers, such as polyesters and polyamides. The process is characterized by the use of a solid support matrix to aid the depolymerization and vapor phase stripping of the monomer for polymer recycling, especially for polyester and polyamide (see page 3, lines 35 to page 4, line 2). As the starting (waste) polyester, polyethylene terephthalate (PET), poly-propylene

terephthalate, and poly(1,4-butylene) terephthalate are mentioned. For PET, the products include ethylene glycol, dimethyl terephthalate, and bis-beta-hydroxyethyl terephthalate. For other polyesters, the products include C₂ to C₁₆ diols, such as 1,3-propanediol and 1,4-butane diol.

The depolymerization agent for the polyester can be a low molecular weight oligomer of a polyester, an alcohol, such as methanol, monomer, or an alkanediol, especially, ethylene glycol, and water (see page 7, lines 9 to 16 of Gallagher). By stripping gas is meant a material that is a gas at reaction temperatures and pressures and is able to carry away the volatile products. The stripping gas may be the depolymerization agent itself as long as such depolymerization agent yields a volatile product, for example, alcohol and alkanediol for PET. The stripping gas passes through the reaction vessel and carries away the volatile monomers (see page 7, lines 27 to 33).

Gallagher describes complete depolymerization of polyester by methanolysis, using methanol in the vapor phase (see page 7, lines 9-26; page 30, claim 11). In the typical methanolysis of PET, the operating temperature can range from about 220 to about 250°C (see page 11, lines 13 to 21). Examples 24 to 27 relate to 3GT in which decompositions are carried out at a maximum temperature of about 225°C using methanol as the depolymerization agent (concurrently also as stripping agent) for 12 hours to obtain recovered residues.

It is acknowledged that 1,3-propanediol is one of the products obtained by the depolymerization of 3GT in Examples 24 to 27 of Gallagher. However, 1,3-propanediol containing acrolein in an amount not greater than 0.5 wt% with a Hazen Color No. less

than 40, as set forth in claim 13, is not found in any of the teachings of Gallagher. No component of the residues recovered in the examples of Gallagher is given, although each residue appears to be a mixture of common reaction products, including terephthalate, 1,3-propanediol, bis-(3-dihydroxyether) terephthalate, etc. No isolated single reaction product is described in these examples of Gallagher.

However, in the Examiner's opinion, it would have been obvious to one skilled in the art "to produce the desired product with the claimed impurity" by optimizing the Gallagher process by routine experimentation. On the contrary, it is submitted that it would not have been so obvious to one skilled in the art because it is not possible to obtain 1,3-propanediol with the claimed amount of acrolein and the Hazen Color Number from anything taught in Gallagher.

In support of applicants' position, enclosed is a Rule 132 Declaration of Dr. Jinichiro Kato, one of the inventors of this application. In this Declaration, Dr. Kato compared the properties of the 1,3-propanediol recovered from the depolymerization process of PPT (=3GT) of Comparative Example F of Gallagher with the claimed properties of the monomer of claim 13 and the properties of a PPT polymer prepared from the recovered 1,3-propanediol with the claimed L and b values of the polymer of claims 17 and 18.

As an initial matter, the Examiner apparently is making a distinction between the polypropylene terephthalate (PPT) polymer of Gallagher and the poly(trimethylene terephthalate) (PTT or 3GT) polymer of the invention saying they differ only by a hydrogen. (Page 5, lines 7-11 of the Office Action). However, in the opinion of Dr. Kato as set forth on page 2, line 13 to page 3, line 14 of his Declaration, the PPT polymer of

Gallagher and the PTT or 3GT polymer of applicants' invention are the same polyester. In other words, applicants do not believe there is any difference between the polymer's structures.

As noted in the Declaration in Section B(1), Dr. Kato repeated the process of Gallagher and obtained a 1,3-propanediol product (PDO) having an acrolein content of 1.7 wt.% and a Hazen Color Number of 90. See Section C(1). This is in contrast to applicants' claimed 1,3-propanediol product that has an acrolein content of ≤ 0.5 wt% and a Hazen Color Number ≤ 40 .

The benefits resulting from these claimed values are discussed above and in Section D of the Declaration. There is nothing in Gallagher that would teach a man skilled in the art how to obtain these values. The only thing taught, as demonstrated in Dr. Kato's declaration, resulted in higher values. Consequently, it is submitted that, contrary to the Examiner's position, it is not possible through "routine experimentation" to obtain applicants claimed values. Therefore the claimed values of the 1,3-propanediol cannot be considered obvious in view of Gallagher.

In addition, as noted in Section B(2) of the Declaration, Dr. Kato prepared a polymer from the recovered PDO of B(1) and obtained a polymer having an L value of 71 and a b value of 18. See Section C(2). This is in contrast to applicants claimed values for the polymer for L of ≥ 75 and for b of ≤ 10 . Since L is a brightness value, the higher the better and b is a yellowing value, the lower the better. See page 13, lines 20-29 of the specification.

There is nothing in Gallagher that would teach a man skilled in the art how to obtain a polymer product from the recovered 1,3-propanediol having these L and b

values. The only thing taught resulted in worse values. Consequently, such values cannot be obtained by "routine experimentation" and therefore the claimed L and b values cannot be considered obvious in view of Gallagher

It is believed claims 13-18 are in condition for allowance and such action is therefore requested. A Request for Continued Examination is being filed with this Response to enable the Examiner to consider the Exhibits and Dr. Kato's Declaration.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Dated: March 24, 2004

By: 

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